

CLAIMS

1. An angle detecting apparatus comprising:
 - a first sensor and a second sensor provided on both ends of a moving portion connected to a fixed portion via an elastic body, the first sensor and the second sensor detecting displacements of the moving portion that is in an oscillating movement; and
 - an angle calculating unit that calculates a displacement angle of the moving portion based on the displacements detected by the first sensor and the second sensor and a distance between the first sensor and the second sensor.
2. The angle detecting apparatus according to claim 1, wherein
 - each of the first sensor and the second sensor is a two-phase sensor.
3. The angle detecting apparatus according to claim 1, further comprising:
 - a third sensor that detects an arbitrary predetermined position of the moving portion, wherein
 - the angle calculating unit includes
 - a direction determining unit that determines an operating direction of each of the both ends of the moving portion based on detection values of the first sensor and the second sensor; and
 - a region determining unit that determines operating regions of the first sensor and the second sensor based on a result of position detection by the third sensor.
 4. The angle detecting apparatus according to claim 1, further comprising:

an encoder plate that includes a slit group provided in a region corresponding to at least a locus of each of the first sensor and the second sensor, wherein

5 the slit group is formed in parallel to a direction connecting the first sensor and the second sensor.

5. The angle detecting apparatus according to claim 1, further comprising:

10 an encoder plate that includes a slit group provided in a region corresponding to at least a locus of each of the first sensor and the second sensor, wherein

the slit group is formed perpendicular to a direction connecting the first sensor and the second sensor.

15 6. The angle detecting apparatus according to claim 4, wherein

the encoder plate includes a light source that emits a light to the first sensor and the second sensor via the slit group, and

20 each of the first sensor and the second sensor functions as a photo-interrupter-type sensor.

7. The angle detecting apparatus according to claim 5, wherein

25 the encoder plate includes a light source that emits a light to the first sensor and the second sensor via the slit group, and

each of the first sensor and the second sensor functions as a photo-interrupter-type sensor.

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8. The angle detecting apparatus according to claim 4, wherein

the slit group is a slit-like detector group that

reflects or scatters lights from the first sensor and the second sensor, and

each of the first sensor and the second sensor functions as a photo-reflector-type sensor.

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9. The angle detecting apparatus according to claim 5, wherein

the slit group is a slit-like detector group that reflects or scatters lights from the first sensor and the second sensor, and

each of the first sensor and the second sensor functions as a photo-reflector-type sensor.

10. The angle detecting apparatus according to claim 4,

15 wherein

the slit group is a slit-like magnet group, and each of the first sensor and the second sensor functions as a magnetic sensor.

20 11. The angle detecting apparatus according to claim 5,

wherein

the slit group is a slit-like magnet group, and each of the first sensor and the second sensor functions as a magnetic sensor.

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12. The angle detecting apparatus according to claim 4,

wherein

the encoder plate is integrally formed.

30 13. The angle detecting apparatus according to claim 5, wherein

the encoder plate is integrally formed.

14. The angle detecting apparatus according to claim 3, wherein

the direction determining unit detects a detection value of the two-phase sensor by multiplying the detection 5 value by four.

15. The angle detecting apparatus according to claim 1, further comprising:

a correction table for correcting an error caused by a 10 distance between the first sensor and the second sensor or an increase in an angle of the first sensor and the second sensor.

16. A scanning-type actuator comprising:

15 an angle detecting apparatus that includes

a first sensor and a second sensor provided on both ends of a moving portion connected to a fixed portion via an elastic body, the first sensor and the second sensor detecting displacements of the moving portion that is in an 20 oscillating movement; and

an angle calculating unit that calculates a displacement angle of the moving portion based on the displacements detected by the first sensor and the second sensor and a distance between the first sensor and the 25 second sensor;

an oscillating unit that oscillates the moving portion; and

an oscillation control unit that controls an oscillation by the oscillating unit based on a result of 30 detection by the angle detecting apparatus.

17. The scanning-type actuator according to claim 16, wherein

each of the first sensor and the second sensor is a two-phase sensor.

18. The scanning-type actuator according to claim 16,
5 wherein

the angle detecting apparatus further includes a third sensor that detects an arbitrary predetermined position of the moving portion, and

the angle calculating unit includes

10 a direction determining unit that determines an operating direction of each of the both ends of the moving portion based on detection values of the first sensor and the second sensor; and

15 a region determining unit that determines operating regions of the first sensor and the second sensor based on a result of position detection by the third sensor.

19. The scanning-type actuator according to claim 16,
wherein

20 the angle detecting apparatus further includes an encoder plate that includes a slit group provided in a region corresponding to at least a locus of each of the first sensor and the second sensor, and

25 the slit group is formed in parallel to a direction connecting the first sensor and the second sensor.

20. The scanning-type actuator according to claim 19,
wherein

30 the encoder plate includes a light source that emits a light to the first sensor and the second sensor via the slit group, and

each of the first sensor and the second sensor functions as a photo-interrupter-type sensor.

21. The scanning-type actuator according to claim 19,
wherein

the encoder plate is integrally formed.

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22. The scanning-type actuator according to claim 18,
wherein

the direction determining unit detects a detection
value of the two-phase sensor by multiplying the detection
10 value by four.

23. The scanning-type actuator according to claim 16,
wherein

the angle calculating unit further includes a
15 correction table for correcting an error caused by a
distance between the first sensor and the second sensor or
an increase in an angle of the first sensor and the second
sensor.

20 24. The scanning-type actuator according to claim 16,
wherein

the scanning-type actuator is used as a laser scanning
apparatus.